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# Clinical and radiological manifestations of Covid 2019 patients admitted to al-karak governmental hospital in south Jordan

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## ABSTRACT

**Background:** Coronavirus disease 2019 (COVID-19) pandemic has emerged as an unprecedented health care crisis. There is limited research investigating the clinical and radiological features of COVID-19 patients in Jordan. **Aim:** To describe the clinical and radiological characteristics of COVID-19 patients. **Patients and Methods:** This retrospective observational study was conducted using the data of 145 COVID-19 confirmed patients admitted to Al-Karak Governmental Hospital between December 2020 to February 2021. Epidemiological, clinical, and radiological features of patients were obtained from the hospital electronic records. **Results:** Men were more affected than women, The majority of patients (61.4%) had moderate symptoms and radiological findings of pneumonia, (20%) of patients had mild symptoms such as fever, dry cough, arthralgia, and (18.6%) of patients admitted with severe symptoms. The most common clinical symptoms were shortness of breath (14.9%), cough (12.4%), chest pain (6.2%), and fever (4.8%). The most common underlying comorbidities were hypertension (47%), diabetes mellitus (19.3%), and heart diseases (4.1%). The predominant pattern of abnormality observed were ground-glass opacities (GGOs) (69.7%) and consolidation (23.2%), peripheral (23.3%) and bilateral (95.3%) distribution, which mainly involved the lower lobes (30.2%). **Conclusion:** Our study demonstrates similar clinical and radiological characteristics of COVID-19 patients in previously reported studies in other countries. Chest radiography and CT scan are important tools for diagnosis and follow up of pulmonary diseases associated with COVID-19. Chest radiography could be used as a tool for identifying COVID-19 pneumonia but is less sensitive than CT scan.

**Keywords:** SARS-CoV-2, COVID-19, Coronavirus, Pneumonia, Chest CT scan, Jordan.



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## 1. INTRODUCTION

In Wuhan, Hubei province, China, on December 2019, the novel corona virus reflected the attention of the health care workers because of causing clusters of pneumonia, it has rapidly spread across China and many other countries and has since developed into a global health pandemic (Huang et al., 2020). The novel coronavirus is referred to as “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2) potentially resulting in “coronavirus disease” (COVID-19) (Lu et al., 2020). The WHO declared COVID-19 as a pandemic on 11 March 2020. So far, COVID-19 has affected more than 120,825,779 patients, caused 2,673,650 deaths worldwide and has become a major global health concern (Worldmeters, 2021). Clinical symptoms of COVID-19 vary in severity; some patients may be asymptomatic. Others may have mild symptoms and some patients may have severe disease and can lead to serious outcomes, such as acute respiratory distress syndrome (ARDS), coagulation dysfunction, multi organ failure and death (Wu and McGoogan, 2020). It is spread by human-to-human transmission via droplets or direct contact, and infection has been estimated to have mean incubation period of 6.4 days and a basic reproduction number of 2.24–3.58 (Borges et al., 2020).

On 2 March 2020, the first case of COVID-19 was reported in Jordan, and the government forced a nationwide lockdown and curfew, detection of cases, PCR testing and extensive contact tracing, quarantine of asymptomatic contacts, and hospital isolation to face the outbreak. The Ministry of Health in Jordan assigned special hospitals to deal with the confirmed cases and to provide medical care for patients with COVID-19 infection (Alkhatatbeh et al., 2020). A study conducted by Alqutob et al., (2020) who described Jordan’s response to the COVID-19 pandemic, scenarios, different proposed strategies and measures and recommendations to control the COVID-19 crisis in Jordan. These recommendations include increase the capacity and the number of trained health staff in the area of public health and epidemiology, infection prevention and control measures and increase the resources of ICUs and respirators.

On 16 March 2021, COVID-19 has affected more than 486,470 patients, caused 5,428 deaths and 401,319 patients have recovered in Jordan (Worldmeters, 2021). Few studies have been conducted to explore the clinical and radiological findings of COVID-19 patients admitted to hospitals in Jordan. A study by Samrah et al., (2020) reported the first COVID-19 outbreak in northern Jordan, the epidemiological features, clinical characteristics, radiological and laboratory findings of 81 patients admitted to hospital were described. Most of the patients were either asymptomatic or had mild symptoms, the mean age was 40 years, and the most common symptoms were nasal congestion, sore throat and dry cough. No studies have been conducted in COVID-19 patients admitted to hospitals in south of Jordan.

This the first retrospective study aims to describe the clinical and radiological characteristics of COVID-19 infective patients admitted to Al-Karak Governmental Hospital in Al-Karak city, in southern Jordan. To the best of our knowledge this is the first retrospective study to describe the clinical and radiological characteristics of COVID-19 patients in south of Jordan.

## 2. PATIENTS AND METHODS

### Study design and participants

This is a retrospective observational study was conducted in patients admitted to Al-Karak Governmental Hospital in south Jordan from December 2020 to February 2021. Al-Karak Governmental Hospital is a 300-bed teaching hospital located in Al-Karak city in the south of Jordan. A cohort of 145 patients with confirmed SARS-CoV-2 infection was included. All patients enrolled in this study were diagnosed with COVID-19 through realtime (RT)-PCR obtained through nasopharyngeal swabs, which were processed and validated through a regional Governmental lab belongs to the Ministry of Health. Epidemiological, clinical, and radiological characteristics and outcomes data were obtained with standardized data collection form from the hospital electronic records. All collected data were reviewed and checked by a medical team. The following epidemiological and clinical data were collected, including age, sex, comorbidities (diabetes, hypertension, cardiovascular disease, chronic obstructive pulmonary disease (COPD), malignancy, and chronic kidney disease and other medical conditions) and clinical symptoms (fever, highest body temperature (°C), cough, dyspnea, general weakness, headache, arthralgia, chest pain and vomiting), and survival status. All chest computed tomography (CT) examinations for the screening of SARS-CoV-2 pneumonia were performed without the use of contrast material. High resolution chest CT scans were reviewed for 43 patients and chest radiographs were reviewed for 116 patients. The lung window setting approach was used for the interpretation of the images. The CT images were assessed, following a standardized protocol, for the presence and distribution of the following abnormalities: ground-glass opacities (GGO), nodules, linear densities, consolidations, pleural effusion, lymphadenopathy, and white lung. The radiological findings were interpreted by a certified consultant radiologist. The approval of the study was obtained after approval from both the Ethical and the Scientific Committees of the Faculty of Medicine at Mutah University.

The severity of the disease was classified based on the following criteria: 1) mild disease was defined as patients with upper respiratory tract symptoms (such as headache, myalgia, body pain, fever or dry cough) with the absence of clinical or radiological findings of pneumonia; 2) moderate disease was defined as symptomatic patients with radiological signs of pneumonia; 3) severe disease was defined as confirmed COVID-19 pneumonia with an oxygen saturation SpO<sub>2</sub> less than 93% at rest, and lung infiltration more than >50% (Shabrawishi et al., 2020).

### 3. RESULTS

#### Clinical findings

There were 86 (59.3%) men and 59(40.7%) women included in this study. The mean age was 62.2 years (SD: 15.9 years) and ranged between 20 and 91 years. The most common symptoms at presentation were shortness of breath (14.9%, n = 21), cough (12.4%, n = 18), chest pain (6.2%, n =9), and fever (4.8%, n = 7). The most common comorbidities were hypertension (47%, n =32.4), diabetes mellitus (DM) (19.3%, n =28), and hart diseases (4.1%, n =6). Mortality rate was 20% (29/145). Regarding the severity of hospitalized patients, 29 patients (20%) had mild symptoms, 89 (61.4%) had moderate symptoms with pneumonia, and 27 patients (18.6 %) had severe symptoms with pneumonia and SpO<sub>2</sub> less than 93% at rest, and lung infiltration more than >50%. Patients' characteristics and clinical findings are presented in Table 1.

**Table 1** Demographic data, underlying medical conditions, clinical findings of patients

	No. (%)		
Total no.	145		
Sex:			
Male	86 (59.3%)		
Female	59 (40.7%)		
Age mean±SD (years)	62.2±15.9		
Severity	Mild cases n %	Moderate cases no.%	Severe cases no.%
	29 20	89 61.4	27 18.6
Symptoms:	21 (14.9%)		
Shortness of breath	18 (12.4%)		
Cough	9 (6.2%)		
Chest pain	7 (4.8%)		
Fever	2 (1.4%)		
Arthralgia	1 (0.7%)		
General weakness	1 (0.7%)		
Headache	1 (0.7%)		
Vomiting			
Comorbidities:	47 (32.4%)		
Hypertension	28 (19.3)		
Diabetes mellitus	6 (4.1%)		
Heart diseases	5 (3.4%)		
CVA	5 (3.4%)		
Hyperlipidemia	4 (2.8%)		
IBS	3 (2.1%)		
Bronchial asthma	2 (1.4%)		
Breast Cancer	2 (1.4%)		
Hypothyroidism	2 (1.4%)		
Lymphoma	2 (1.4%)		
Mental retardation	1 (0.7%)		
COPD	1 (0.7%)		
RA	1 (0.7%)		
Depression	1 (0.7%)		

Epilepsy	1 (0.7%)
OA	1 (0.7%)
Kidney diseases	1 (0.7%)
Major thalassemia	1 (0.7%)
Pulmonary edema	1 (0.7%)
Brain mass	

CVA=Cerebrovascular vascular accident, IBS=Irritable bowel diseases, COPD=Chronic obstructive pulmonary disease, RA=Rheumatoid arthritis, OA=Osteoarthritis

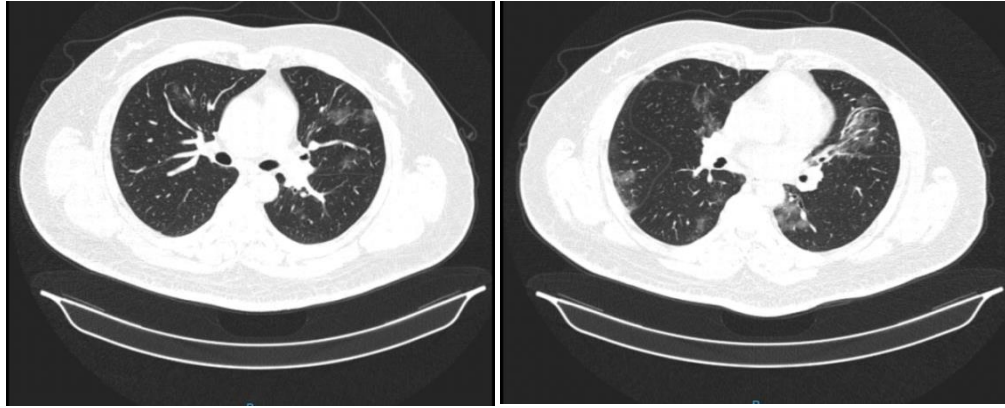
## Radiologic findings

### High resolution chest CT scan

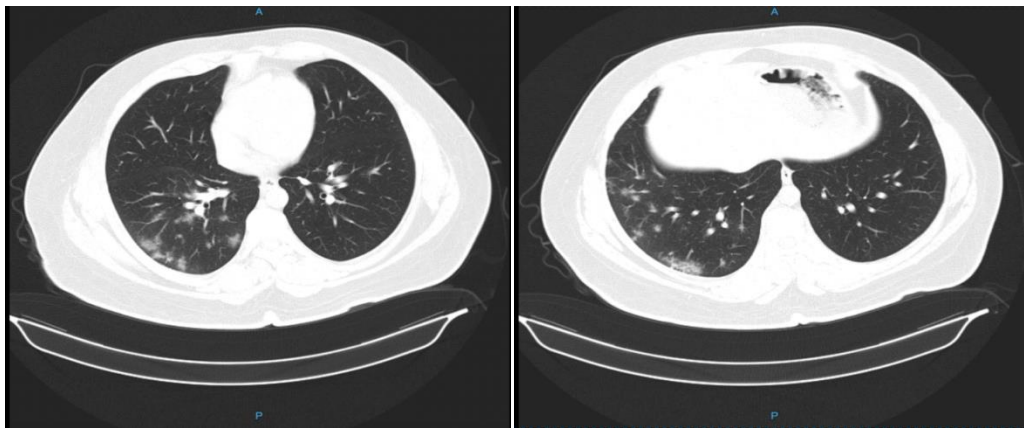
High resolution chest CT-scans were reviewed for 43 patients. One patient had normal CT radiological findings at admission. The most common CT finding were ground-glass opacities GGOs (69.7%, n=30), and consolidation (23.2%, n=10). Regarding the laterality, bilateral involvement was more common (95.3 %, n =41). The predominant pattern of abnormality affected all lobes (diffused) (41.8%, n =18), and only (30.2%, n =15) involved lower lobes. Peripheral distribution was the most frequent findings (23.3%, n =10). Chest CT imaging findings are summarized in Table 2. Figures (1, 2, 3, 4) show non-contrast enhanced chest CT Scan of COVID-19 pneumonia patients with different disease severity.

**Table 2** High resolution chest CT- characteristics

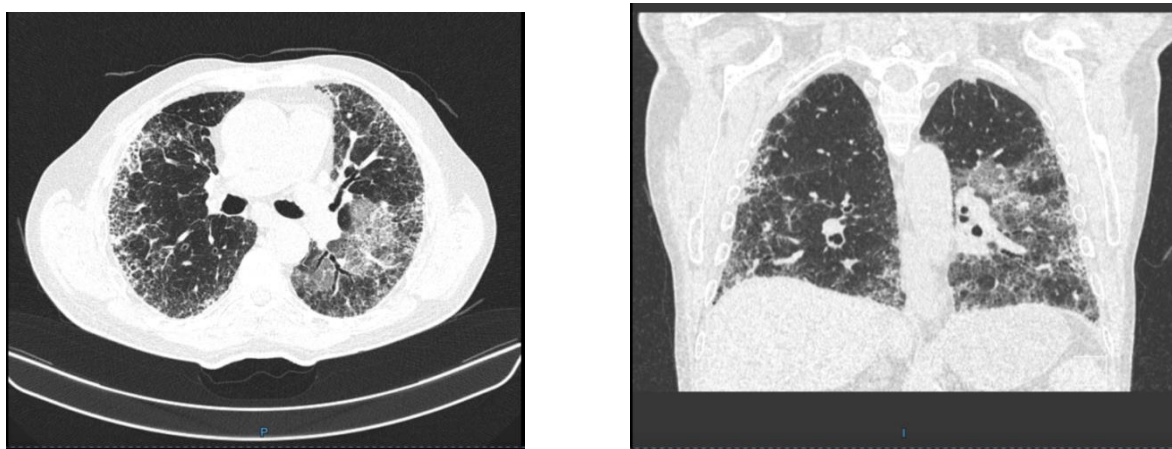
Chest CT findings	Total no. 43	
	No.	%
Normal	1/43	2.3%
Laterality		
Bilateral	41/43	95.3%
Unilateral right	1/43	2.3%
Unilateral left	1/43	2.3%
Predominant finding		
Ground-grass opacities	30/43	69.7%
Nodules	2/43	4.6%
Linear densities	0	0%
Consolidation	10/43	23.2%
White lung	0	0%
Mediastinal lymph-nodes enlargement	4/43	9.3%
Pleural effusion	2/43	4.6%
Zonal predominance		
Upper	0	0%
Middle	8/43	18.6%
Lower	15/43	30.2%
Diffuse (all lobes)	18/43	41.8%
Predominant distribution		
Peripheral	10/43	23.3%
Central	0	0%



**Figure 1** High resolution chest CT scan axial slice of 52 years old patient shows mild burden of disease characterized by diffuse bilateral patchy ground glass opacities mainly in peripheral/subpleural distribution, affecting both upper and lower lungs zones as well as right middle lobe with no zonal predilection, with associated interstitial thickening and subpleural and atelectatic bands seen at the areas of ground glass opacities in keeping with COVID 19 pneumonia. The opacities occupy about 20 % of each lung lobe.

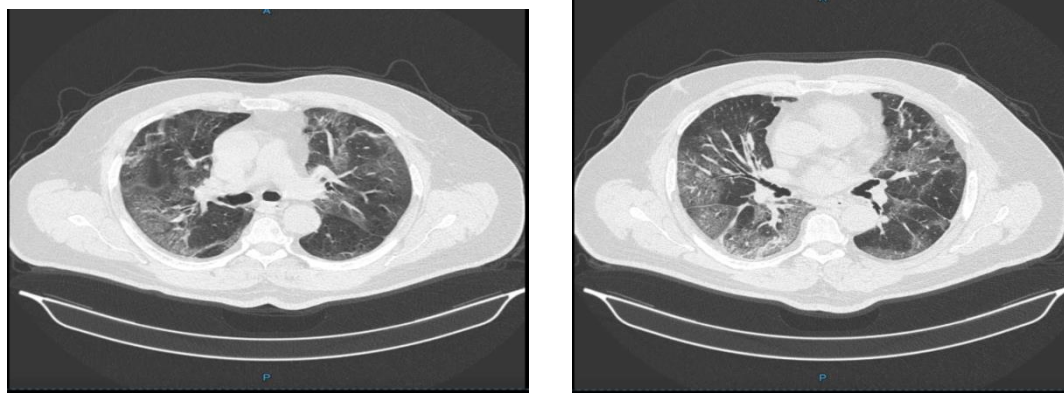


**Figure 2** high resolution chest CT scan axial slices of 25 years old patient shows multifocal, mainly peripheral small patchy ground glass opacities in the upper and lower lobes of right lung with lower lobe predominance in correlation with the patient known history of COVID findings are representing mild disease burden. Posterior subpleural line is seen in the right lung.



**Figure 3** High resolution chest CT scan of patient shows Lung fibrosis with COVID-19 infection involving the left lung. On follow-up imaging there is diffuse bilateral intra-lobular and interlobular interstitial thickening, with associated traction bronchiectasis and diffuse ground glass opacifications. There is also minimal peripheral pleural based honeycombing noted at the both lung fields. There are ground glass opacities seen in the apicoposterior segment of the left upper lobe as well as superior segment of the left lower lobe and superior lingula of the left lung due to superimposed COVID 19 chest infection, Mild burden of COVID 19. There is mild left sided pleural effusion.





**Figure 4** High resolution chest CT scan axial slice of 63years old patient shows moderate to severe burden of disease characterized by diffuse bilateral patchy ground glass opacities mainly in peripheral/subpleural distribution, affecting both upper and lower lungs zones as well as right middle lobe with nozonal predilection, with associated interstitial thickening, subpleural bands and lower lobes atelectatic bands at the areas of ground glass opacities in keeping with COVID 19 pneumonia. The opacities occupy about 60-70% of each lung lobe. There are multiple tiny subpleural lung nodules.

### Chest radiographs

Chest x-rays were reviewed for 116 patients. Thirty-seven patients (31.8%) had normal x-ray findings at admission to hospital. The predominant findings observed were infiltration (50.8%, n=59), and consolidation (12.9%, n=15). Abnormalities were found more frequent in all lobes (29.3%, n=34), bilateral (52.5%, n=61) and peripheral distribution was the more common pattern (25%, n=29). Although the x-rays were normal for 8 patients, abnormal findings were detected with chest CT-scans. Chest x-ray characteristics are presented in Table 3.

**Table 3** Chest radiographs findings

Chest radiographs findings	N (%) n=116
Normal	37/116 (31.8%)
Laterality	
Bilateral	61/116 (52.5%)
Unilateral right	10/116 (8.6%)
Unilateral left	1/116 (0.86)
Predominant finding	
Infiltration	59/116 (50.8%)
Consolidation	15/116 (12.9%)
Pleural effusion	4/116 (3.4%)
Zonal predominance	
Upper	1/116 (0.86%)
Middle	5/116 (4.3%)
Lower	18/116 (15.5%)
Diffuse (all lobes)	34/116 (29.3)
Predominant distribution	
Peripheral	29/116 (25%)
Central	0

## 4. DISCUSSION

To the best of our knowledge, this is the first retrospective observational study assessing the clinical and radiological findings of COVID-19-confirmed hospitalised patients in the southern of Jordan. In this study men were more affected than women and the majority of patients admitted to hospital were elderly (mean age 62.2 years,  $\pm$  SD 15.9 years). Regarding the severity of the disease,

the majority of patients (61.4%) had moderate symptoms and radiological features of pneumonia, followed by (20%) of patients presented with mild symptoms such as fever, dry cough, arthralgia, and only (18.6%) patients admitted with severe symptoms of pneumonia. Mortality rate was 20% (29/145). Several studies reported variation in the severity of signs and symptoms associated with COVID-19 (Wu and McGoogan, 2020; Liu et al., 2020). A Summary of a Report of 72314 cases from the Chinese Center for Disease Control and Prevention reported that most cases were classified as mild (81%; i.e., non-pneumonia and mild pneumonia), 14% were severe (i.e., dyspnea, respiratory frequency >30/min, blood oxygen saturation less than 93%, and 5% were critical (i.e., respiratory failure, septic shock, and/or multiple organ dysfunction or failure (Wu and McGoogan, 2020).

In this study, the most common presented symptoms were shortness of breath (14.9%), followed by cough (12.4%), chest pain (6.2%), and fever (4.8%). Less common symptoms were arthralgia, general weakness, headache, and vomiting. According to our results the most common comorbidities were hypertension (47%), followed by diabetes mellitus (DM) (19.3%), and heart diseases (4.1%). The most common symptoms that have been initially described in the cluster of 41 patients admitted to hospital in Wuhan, Hubei Province, China in January 2020 include fever (98%), cough (76%), and myalgia or fatigue (44%) and less common symptoms were sputum production (28%), headache (8%), hemoptysis (5%), and diarrhea (3%). More than half of patients (55%) developed dyspnea. Pneumonia without any chest CT abnormal findings was detected in 41 patients. About third of patients had underlying diseases, including diabetes (20%), hypertension (15%), and cardiovascular disease (15%) (Huang et al., 2020).

In regard to radiological findings, in our study, the most common CT findings were ground-glass opacities GGOs (69.7%) and consolidation (23.2%). Bilateral involvement was more common (95.3%). The predominant pattern of abnormality affected all lobes (diffused) (41.8%), and (30.2 %) involved only the lower lobes. Peripheral distribution was the most frequent findings (23.3%). These results are consistence with other studies. The scans of the non-enhanced computer tomography retrospective analysis were conducted in the main center in Jordan for the already Covid-19 diagnosed patients. A total of 302 patients were involved in this study, 181 cases (59.9 %) showed no pulmonary changes. Positive findings were present in 121 patients with a total number of 191 computer tomographic scans including initial and follow-up scans. The positive findings were detected in 51 and 70 patients (female and male, respectively) with age range 12-87 years (mean±SD = 46.1±16.5). Patterns of the pulmonary changes were; ground-glass pattern (96.7%), lenticular pattern (32.2 %), Halo sign (15.7%), rounded (14.9 %), nodular (10.7 %), ground-glass with consolidation (8.3%), tree-in-bud (1.7%) and pleural effusion (1.7%). Bilateral lung involvement was more frequently presented in 86 cases (71.1%). The incidence of lobar distribution was the following: right lower (75.2 %), left lower (71.9 %), right upper (62.8 %), left upper (60.3 %) and right middle (50.4 %). The incidence of the involved lobes on the initial scans were as follow: one lobe (24 %), two lobes (10.7%), three lobes (9.1%), four lobes (16.5%) five lobes (36.4 %) (Albtoush et al., 2020). The pattern of lung abnormalities has been initially described in Wuhan, China study were bilateral involvement in 98 % with typical findings in ICU patients on admission included bilateral multiple lobular and subsegmental areas of consolidation findings. The chest CT findings of non-ICU patients were bilateral groundglass opacity and subsegmental areas of consolidation (Huang et al., 2020). Other studies have described typical features of chest CT scan findings in patients with confirmed COVID-19 include multi-lobar involvement (71%), ground-glass opacities (57%), rounded morphology- opacities (33%), peripheral distribution, consolidation with ground-glass opacities (29 %), crazy-paving pattern (19 %) (Chung et al., 2020; Jajodia et al., 2020).

Chest radiography is the most readily available modality for the detection of lung abnormalities and is cheaper and associated with a lower radiation dose compared to chest computed tomography (Jajodia et al., 2020; Lakhkar et al. 2020). Regarding the chest x-ray characteristics, our results showed that thirty-seven patients (31.8%) had normal x-ray findings at admission to hospital. Although the x-rays were normal for 8 patients, radiological features were detected when chest CT-scans were reviewed. These results highlighted the importance of performing chest CT scan in COVID-19 patients with suspected pneumonia and showed that CT is superior for detecting imaging abnormalities than x-ray and that chest CT imaging features could help radiologists for the early detection and diagnosis of COVID-19-associated pneumonia.

The predominant findings observed in our study were infiltration (50.8%), and consolidation (12.9%). Abnormalities were found more frequent in all lobes (29.3%), bilateral (52.5%) and peripheral distribution was the more common pattern (25%). Several published studies reported lack of specificity and sensitivity of chest radiograph for detection of COVID-19, particularly in patients with no or only minor symptoms and imaging is not recommended in patients with mild clinical features unless they are at risk for disease progression. However, imaging is indicated in patients with worsening of respiratory status (Rubin et al., 2020). For example, in suspected COVID-19 with positive PCR, the reported sensitivity of chest radiographs was reported to be (69%), (Wong et al., 2019). Other studies described the most common findings on chest radiographs were multifocal ground-glass opacities and consolidation with a peripheral and lower lung zone predilection and the severity of chestradiography findings peaked at 10–12 days from the onset of symptoms (Lai et al., 2020; Wong et al., 2019; Yoon et al., 2020).

## 5. CONCLUSION

This study demonstrated similarities with previous studies from other countries about the clinical and radiological characteristics of hospitalized patients with COVID-19 pneumonia. Caution must be exercised in interpreting the clinical and radiological data of COVID-19 patients. Clinicians and radiologists should become familiar with the CT findings of COVID-19 and the limitations of chest radiographs in diagnosis and evaluating COVID-19 pneumonia.

### Author contribution

Mahmoud H. Alkhasawneh - Concepts of ideas, literature search, searching similar studies, data acquisition, manuscript Preparation and editing.

Mohammad Alsbou - Manuscript preparation, editing and revision, searching similar studies, data acquisition, manuscript editing.

Ana'am Mohammed - collecting data for analysis, designing the questionnaire questions.

Samir S. Mahgoub - Searching similar studies, data acquisition, designing the questionnaire questions, manuscript preparation and editing.

Yazeed Bagain -Designing the questionnaire questions, statistical analysis of data, manuscript editing.

Hamza Al Majali- Statistical analysis of data, manuscript editing.

Anas Rawashdeh- Designing the questionnaire questions, manuscript preparation.

Hani Al-shagahin- Searching similar studies, data acquisition, designing the questionnaire questions, manuscript preparation and editing.

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### Ethics approval

The study has been approved by the Scientific and Ethics Committees of the Faculty of Medicine, Mutah University, Jordan (The reference number of the ethical approval is: 14032021).

### Conflict of interest/ Competing interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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### Data and materials availability

All data associated with this study are present in the paper.

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